

CENSE INSITE INFORM

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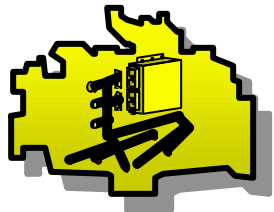
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What is CENSE?

The purpose of the Cense product is to provide a means of achieving

- an increased design life of the engine by limiting life-reducing incidents and progressive damage, and
- providing the customer with greater engine availability



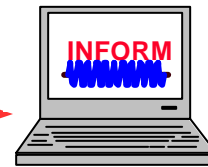
CENSE Hardware

- Control module
- Wiring harnesses
- Sensors
- Fault Lamps



INSITE Software

- Service tool
- Fault information
- Used by Service Technician



INFORM Software

- Information management tool
- Used by Equipment Manager

Engine Sensors

- Advanced engine monitoring integrated into the engine
- The Cense system monitors up to 40 sensors for all major engine subsystems
 - Engine Speed
 - Pre Oil Filter Pressure
 - Post Oil Filter Pressure
 - Oil Temperature
 - Injector Rail Pressure
 - Intake Manifold Pressure
 - Intake Manifold Temperature
 - Coolant Pressure
 - Coolant Temperature
 - Exhaust Temperature (16)
 - Crankcase Pressure
 - Battery Voltage
 - Ambient Pressure
 - Fuel Inlet Restriction
 - ECM Temperature
 - Water in Fuel
 - Key Switch

What has CENSE done for our customers?

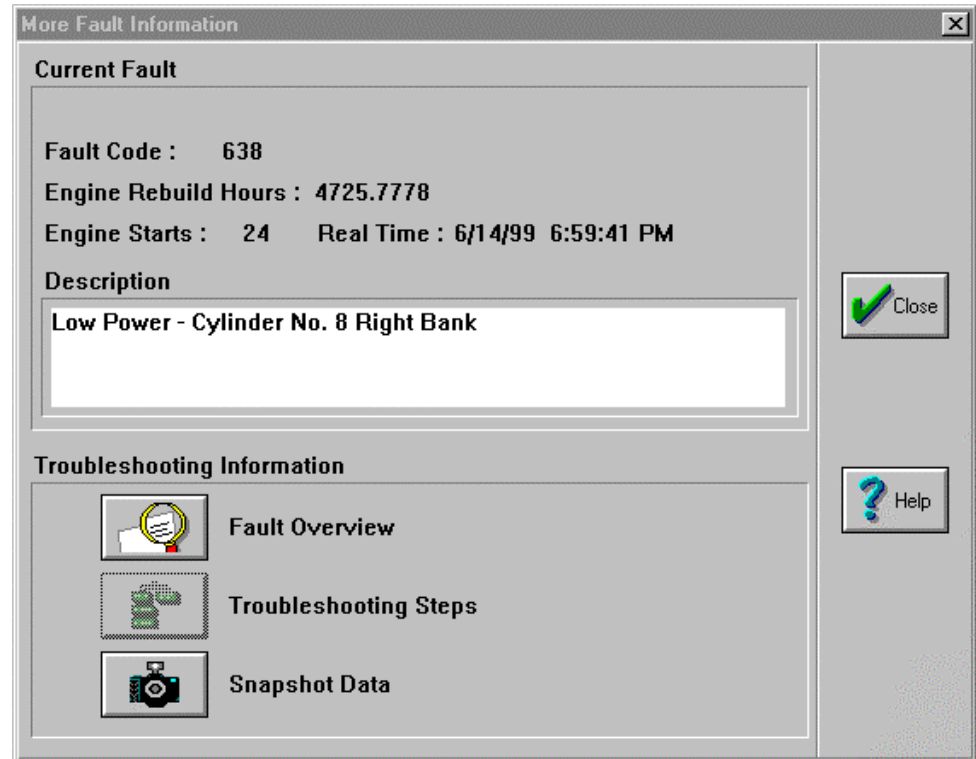
- The CENSE system is being used on hundreds of engines worldwide at many major mine sites
- Here are some of the failures and conditions CENSE has detected for our customers:
 - boost leaks
 - clogged oil filter
 - loss of oil/low oil pressure
 - high coolant temperature
 - high intake manifold air temperature
 - excessive piston/liner wear
 - coolant in the intake manifold
 - high oil level
 - loose injector hold-down clamp
 - engine overspeed
 - hot shutdown
 - low coolant level
 - failed thermostat

Engine monitoring and diagnostics

- Three cab mounted lamps alert the operator to fault conditions
 - Operator can determine exact fault code and cause using fault flashout at key-on and a fault code list
 - Red Stop/Shutdown
 - Amber Warning
 - Blue Maintenance
- INSITE tool is used by service technician to pinpoint cause of problem and assist with the repair
- INFORM provides long term analysis of the data collected by INSITE

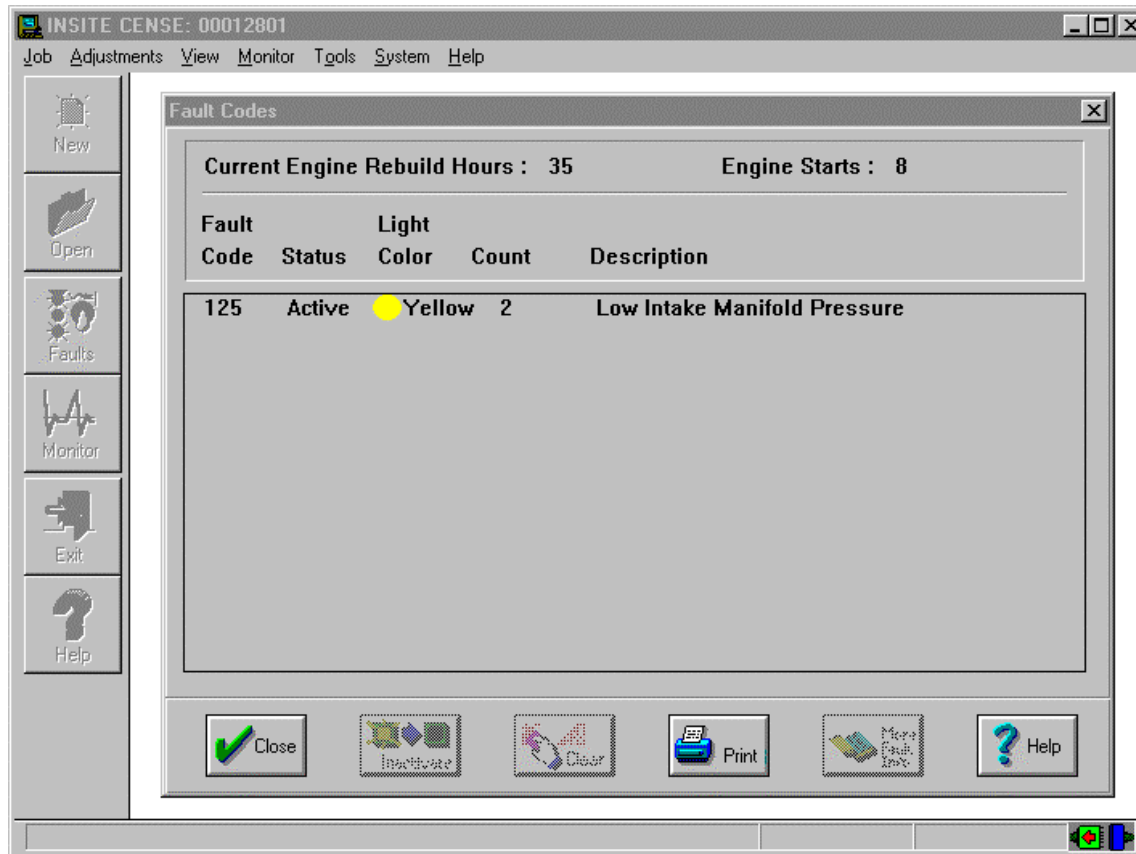
INSITE service tool

- The Insite Service tool tells the Service Technician:
 - What is wrong
 - When it happened
 - Where the problem is
 - How to fix it



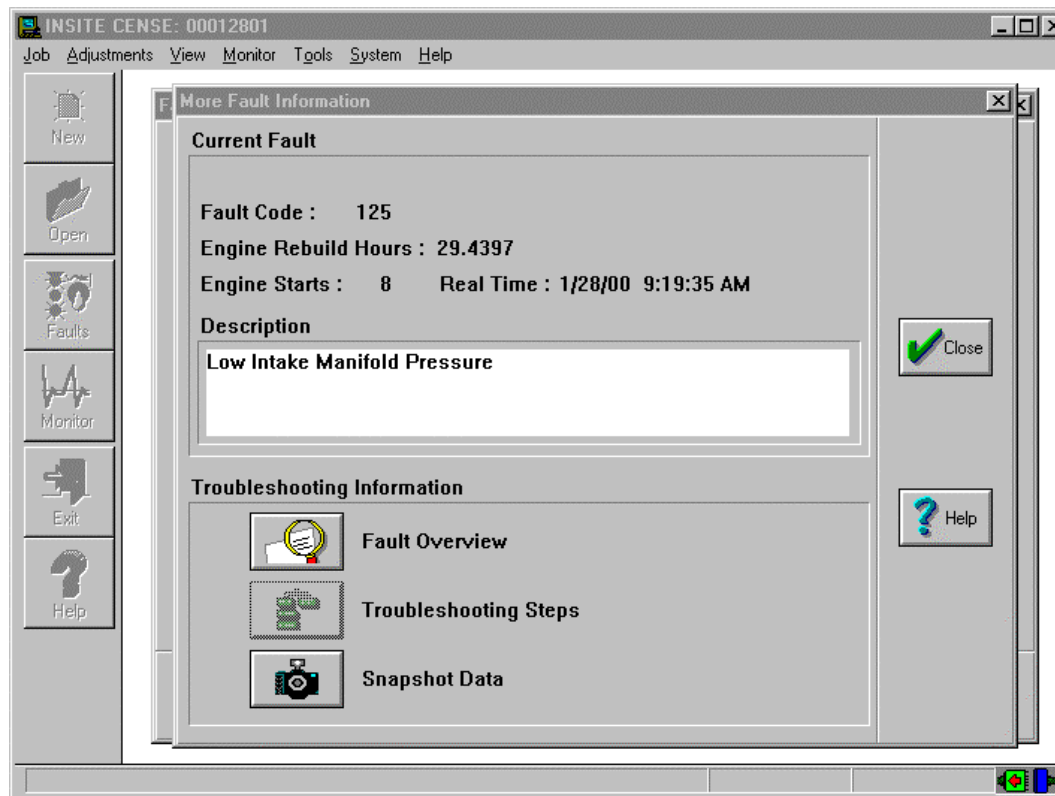
INSITE service tool - Fault log

- Look at the fault log by clicking on “Faults”



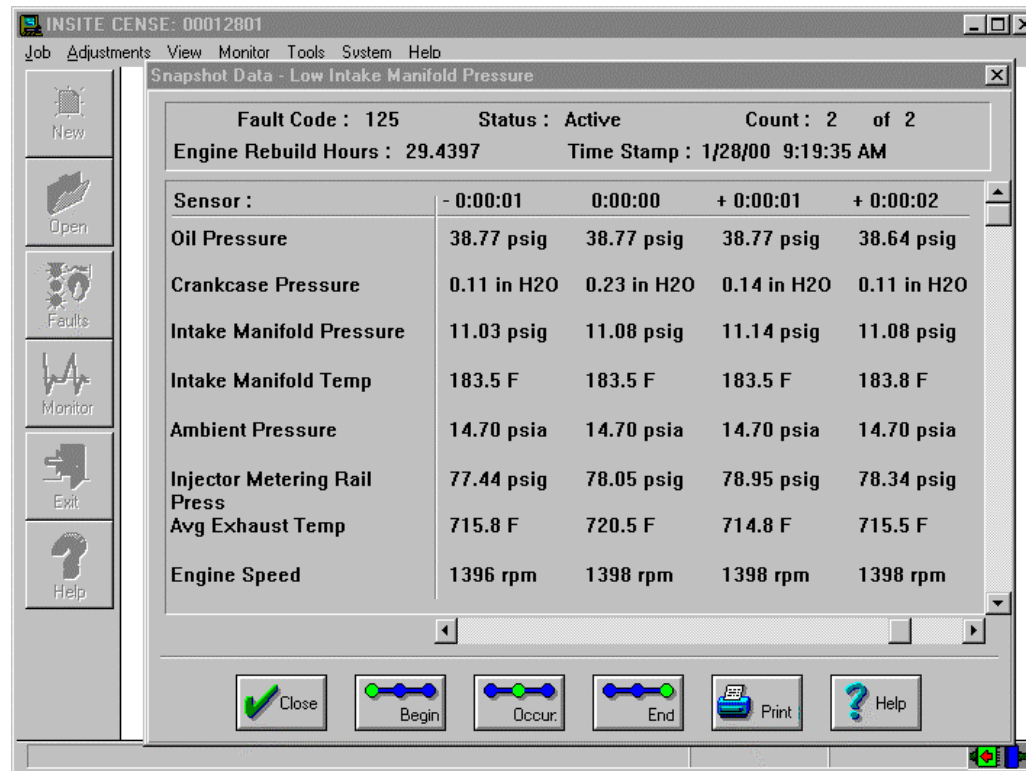
INSITE service tool - Fault log

- Double-click on the fault code to get more information



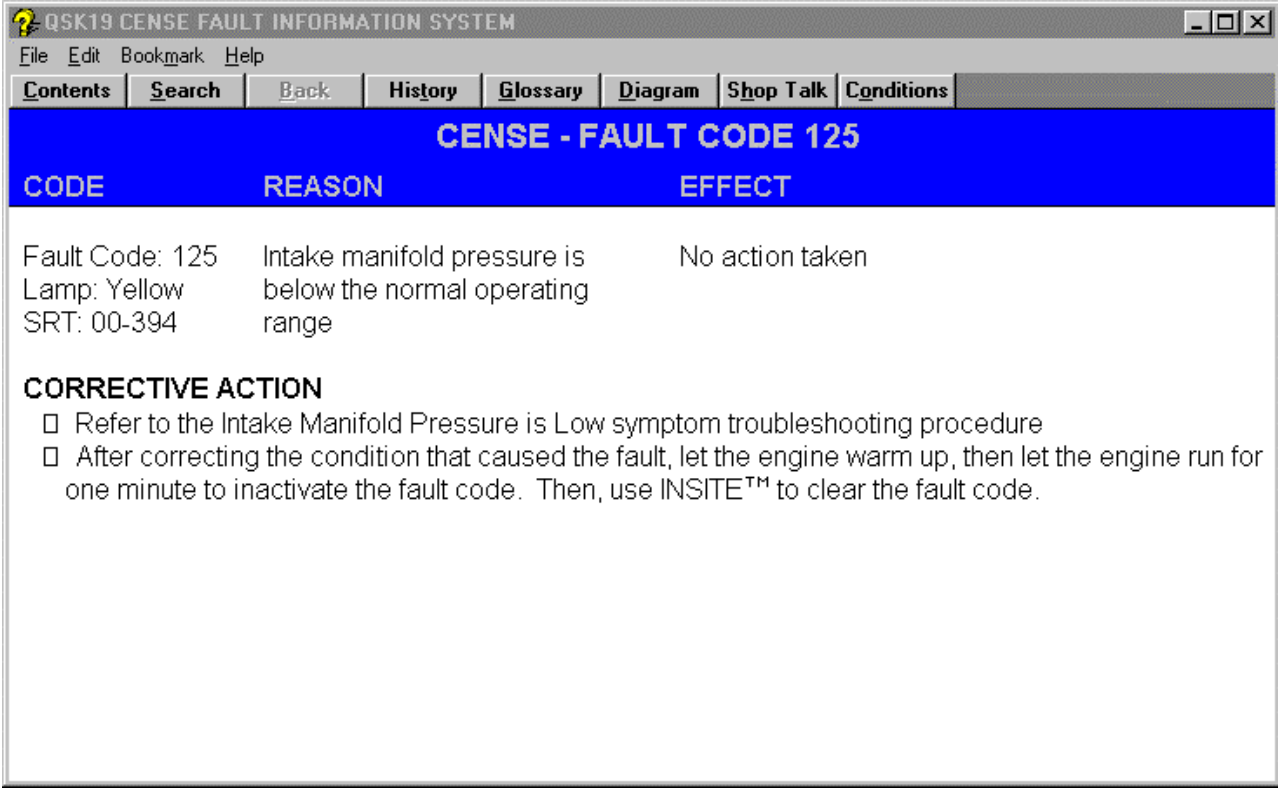
INSITE service tool - Snapshot

- Need more info about what the engine was doing when the fault was logged? Look at the snapshot data.
- Snapshot records data 4 min before and 30 sec after at 1 Hz



INSITE service tool - Fault Information System

- Need more info on the fault? Click on “Fault Overview”



The screenshot shows a software window titled "QSK19 CENSE FAULT INFORMATION SYSTEM". It has a menu bar with "File", "Edit", "Bookmark", and "Help". Below the menu bar is a tabbed interface with tabs for "Contents", "Search", "Back", "History", "Glossary", "Diagram", "Shop Talk", and "Conditions". The "Contents" tab is active, displaying a table for "CENSE - FAULT CODE 125".

CODE	REASON	EFFECT
Fault Code: 125 Lamp: Yellow SRT: 00-394	Intake manifold pressure is below the normal operating range	No action taken

CORRECTIVE ACTION

- ☐ Refer to the Intake Manifold Pressure is Low symptom troubleshooting procedure
- ☐ After correcting the condition that caused the fault, let the engine warm up, then let the engine run for one minute to inactivate the fault code. Then, use INSITE™ to clear the fault code.

INSITE service tool - Fault Information System

- What are the steps to troubleshoot this problem?

The screenshot shows a software window titled "QSK19 CENSE FAULT INFORMATION SYSTEM". It has a menu bar with "File", "Edit", "Bookmark", and "Help". Below the menu bar is a tabbed interface with tabs for "Contents", "Search", "Back", "History", "Glossary", "Diagram", "Shop Talk", and "Conditions". The main content area has a blue header with the text "CENSE - FAULT CODE 136" and "TROUBLESHOOTING STEPS". Below this header, there is a "CAUTION" icon and the word "STEPS". The content is organized into a table with two columns: "STEPS" and "SPECIFICATION".

STEPS	SPECIFICATION
<u>STEP 1:</u> Check for multiple fault codes. <u>STEP 1A:</u> Read fault codes.	Fault Codes 212 and 347 are not active
<u>STEP 2:</u> Check the oil pressure sensor. <u>STEP 2A:</u> Inspect the main harness and sensor connector pins. <u>STEP 2B:</u> Check the supply voltage. <u>STEP 2C:</u> Check the signal voltage.	No damaged pins 4.75 to 5.25 volts 1.62 to 1.74 volts
<u>STEP 3:</u> Check the main harness. <u>STEP 3A:</u> Inspect the 40 pin "A" and "B" Deutsch connector pins on the main harness and the ECM. <u>STEP 3B:</u> Check for a short circuit from the signal wire to all other wires in the main harness.	No damaged pins More than 10k ohms
<u>STEP 4:</u> Clear fault code. <u>STEP 4A:</u> Disable fault code. <u>STEP 4B:</u> Clear inactive fault codes.	Fault Code 136 inactive All fault codes cleared

INSITE service tool - Fault Information System


- Need more detail on troubleshooting, such as a wiring diagram? Just drill down.

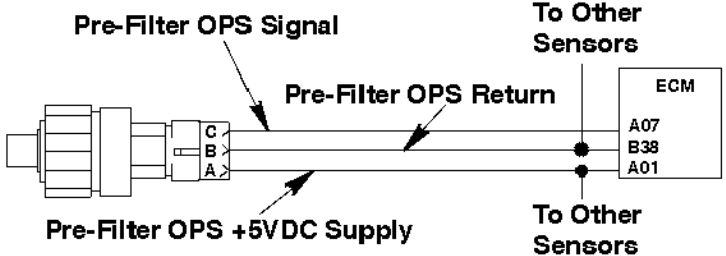
QSK19 CENSE FAULT INFORMATION SYSTEM

File Edit Bookmark Help

Contents Search Back History Glossary Diagram Shop Talk Conditions

FAULT CODE 136 STEP 1 SUMMARY

STEPS	SPECIFICATION	ACTION
STEP 1: Check for multiple fault codes. STEP 1A : Read fault codes.	Fault Codes 212 and 347 are not active	 Go to Multiple fault code troubleshooting procedure



Pre-Filter OPS Signal

Pre-Filter OPS Return

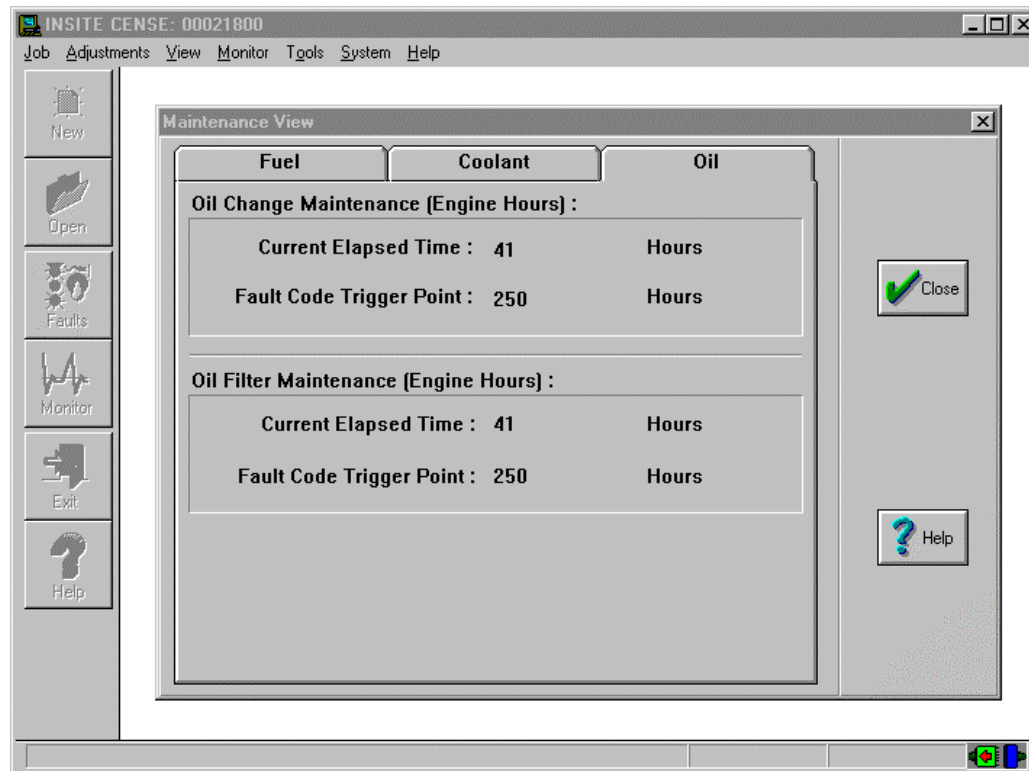
Pre-Filter OPS +5VDC Supply

To Other Sensors

ECM
A07
B38
A01

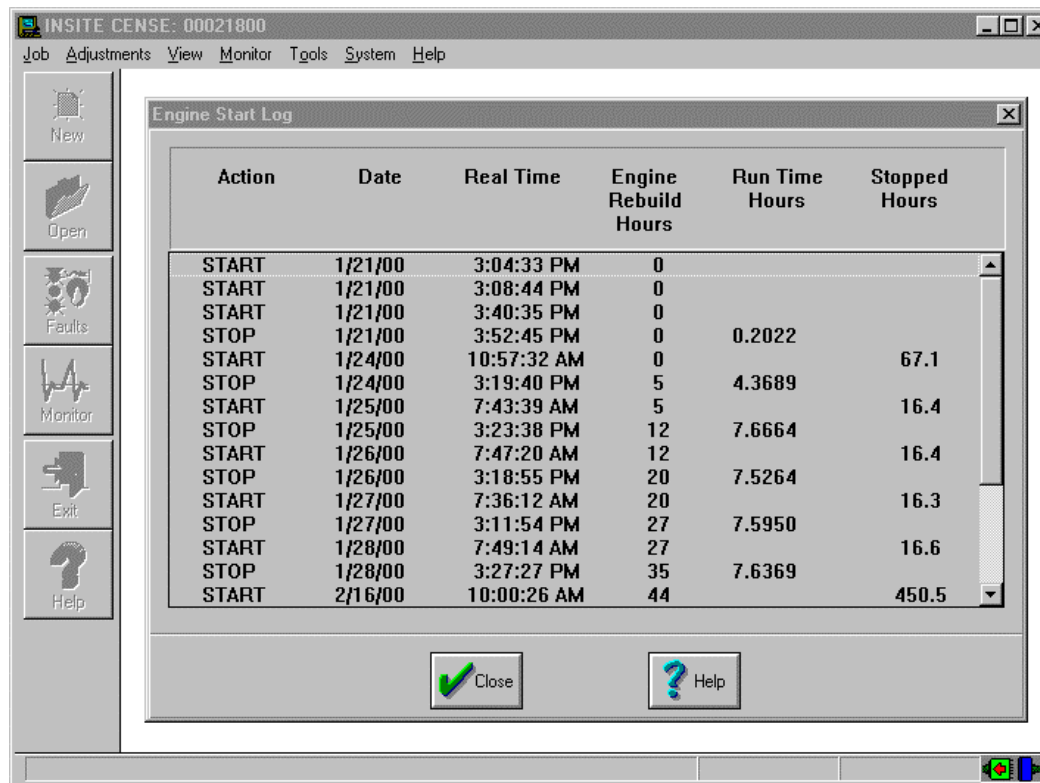
INSITE service tool - Maintenance Monitor

- Do I need to change oil? Coolant? Filters? Check the maintenance monitor.
- Blue maintenance light comes on when maintenance is needed



INSITE service tool - Start-stop log

- Start-stop log shows when the engine has run and for how long



Action	Date	Real Time	Engine Rebuild Hours	Run Time Hours	Stopped Hours
START	1/21/00	3:04:33 PM	0		
START	1/21/00	3:08:44 PM	0		
START	1/21/00	3:40:35 PM	0		
STOP	1/21/00	3:52:45 PM	0	0.2022	
START	1/24/00	10:57:32 AM	0		67.1
STOP	1/24/00	3:19:40 PM	5	4.3689	
START	1/25/00	7:43:39 AM	5		16.4
STOP	1/25/00	3:23:38 PM	12	7.6664	
START	1/26/00	7:47:20 AM	12		16.4
STOP	1/26/00	3:18:55 PM	20	7.5264	
START	1/27/00	7:36:12 AM	20		16.3
STOP	1/27/00	3:11:54 PM	27	7.5950	
START	1/28/00	7:49:14 AM	27		16.6
STOP	1/28/00	3:27:27 PM	35	7.6369	
START	2/16/00	10:00:26 AM	44		450.5

INFORM Fleet Management Software

Information management software



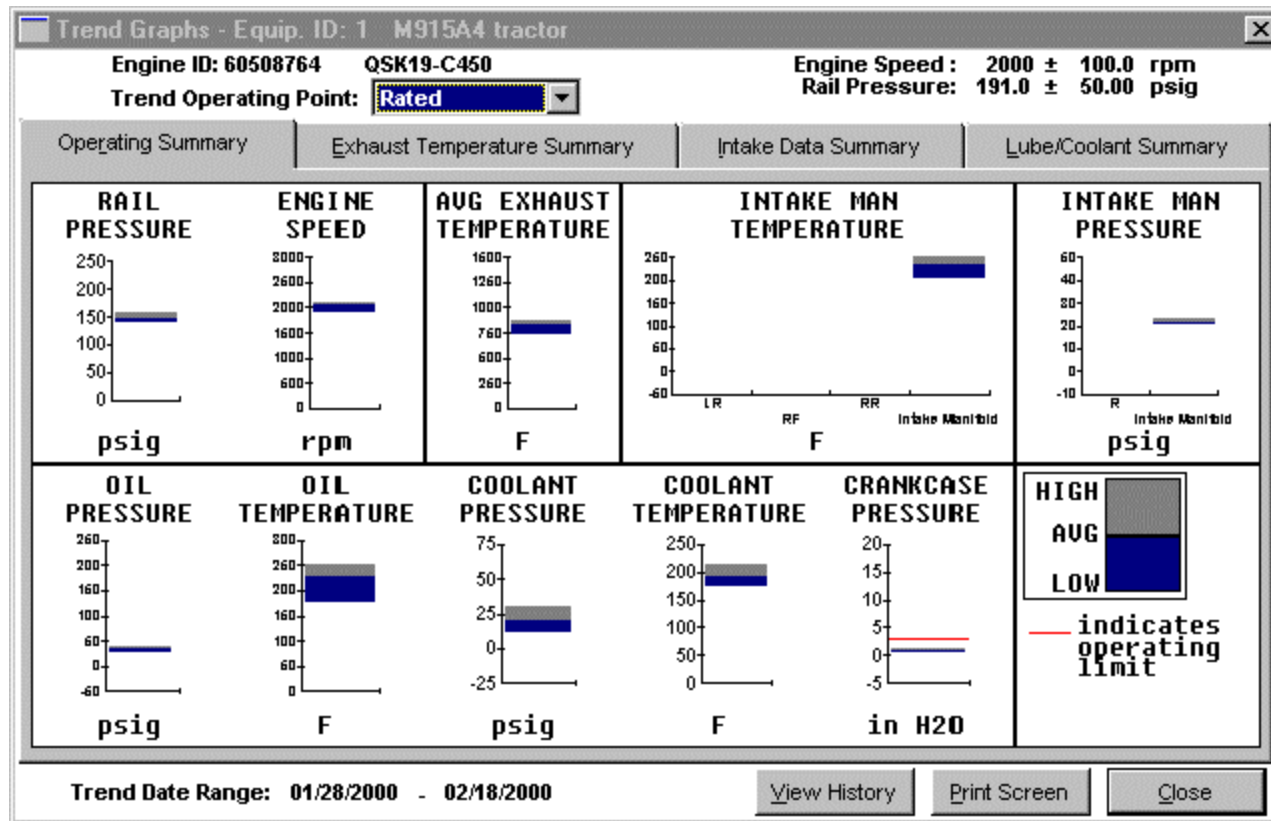
- **Look at trends in maintenance and machine utilization**
- **Compare performance and uptime history of suppliers and machines**
- **Project maintenance and rebuild schedules**
- **Keep track of all the Cummins powered equipment in your operation**

INFORM Fleet Management Software

- **Cense engine data downloaded using Insite**
- **Data is periodically uploaded into Inform**
- **Inform lets you view the data in different ways**
- **Inform generates reports useful in managing a fleet**

INFORM Fleet Management Software

- Operating summary - how is my engine running?



INFORM Fleet Management Software

- Engine Detail Report gives operating parameters in numerical form

02/21/2000

Engine Detail Report

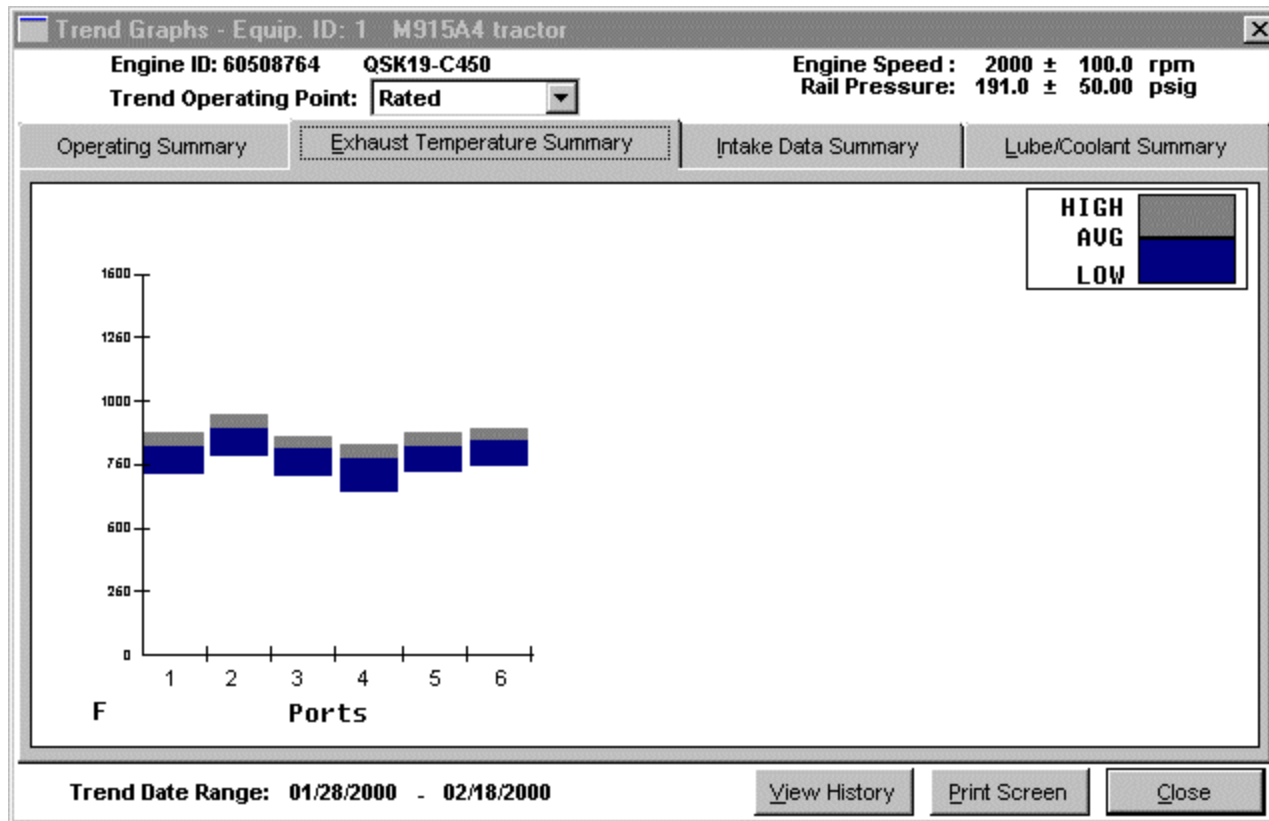
Page 1

All Equipment where Date Range is All Data, and Equipment ID is 1, and
Operating Point is Rated

Engine	Rail Pressure	Engine Speed	Average Exhaust Temp	Intake Manifold Temperature				Intake Manifold Pressure		Oil Pressure	Oil Temp	Coolant Pressure	Coolant Temp	Crankcase Pressure
				LF	LR	RF	RR	Left	Right					
60508764														
Min	141.16	1900.00	735.00	203.50	0.00	0.00	0.00	20.47	0.00	41.69	176.25	10.80	175.25	0.63
Avg	145.45	2060.05	832.64	235.59	0.00	0.00	0.00	21.75	0.00	43.69	227.49	20.68	192.93	0.85
Max	157.02	2100.00	865.25	250.00	0.00	0.00	0.00	22.67	0.00	46.81	251.00	30.42	214.00	1.05

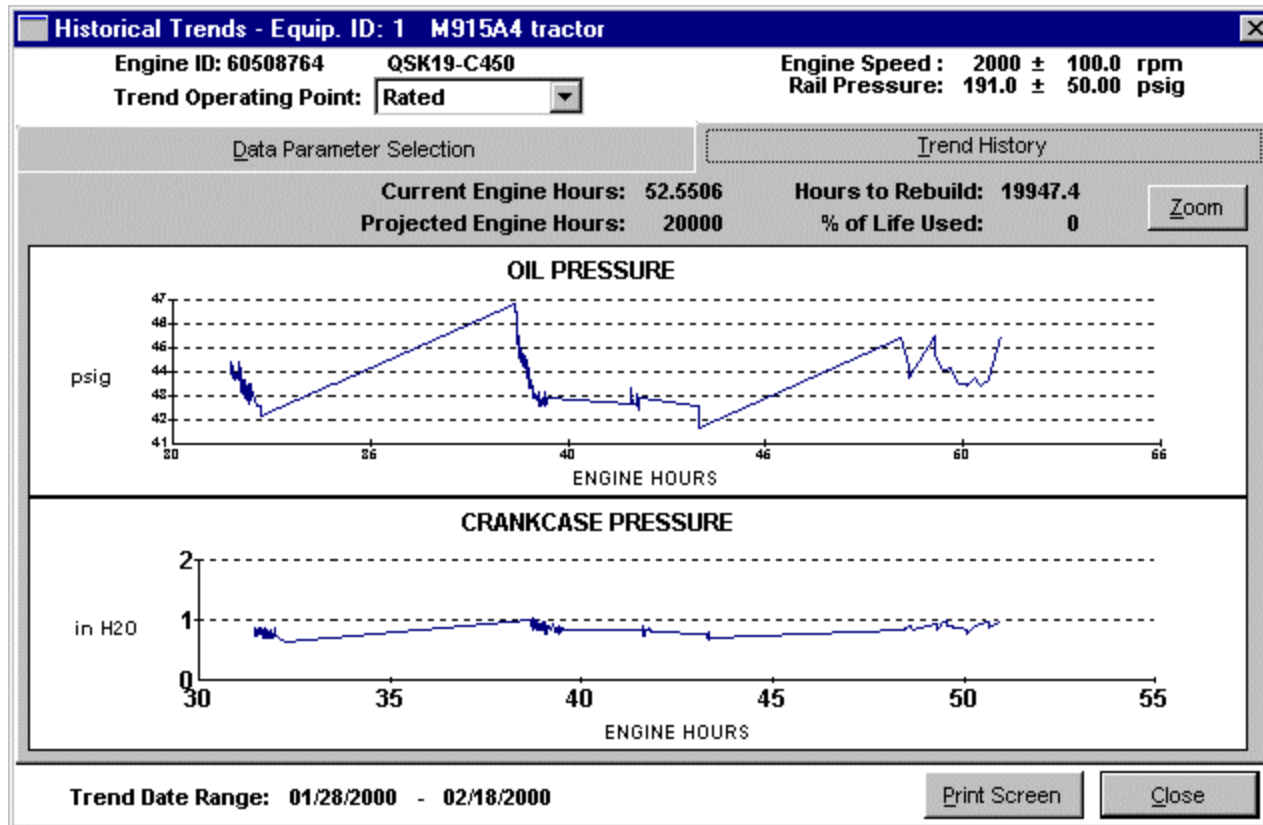
INFORM Fleet Management Software

- How are my individual exhaust temps doing? Is one cylinder going bad?



INFORM Fleet Management Software

- How is blowby trending? When do I need to rebuild?



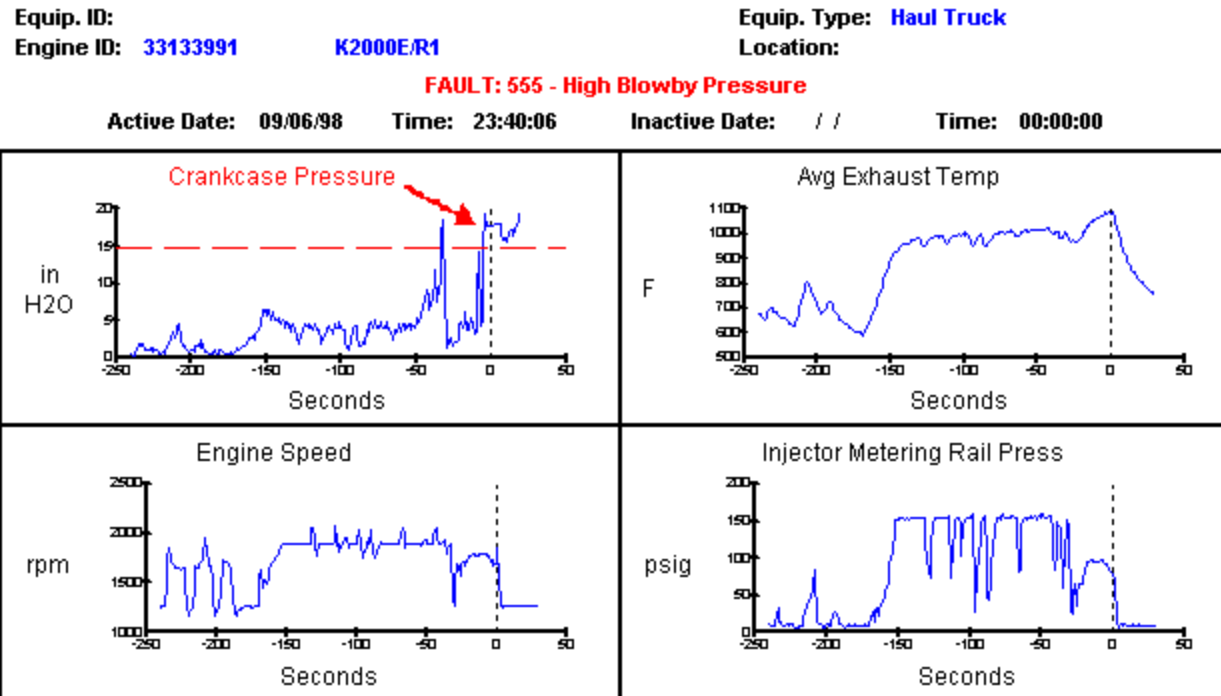
INFORM Fleet Management Software

- **Engine Fault Summary Report - see all fault activity for the entire fleet**

02/21/2000	Fault Summary	Page 3
All Equipment where Date Range is All Data		
<u>The following equipment had fault conditions.</u>		
611	622-Low Power - Cylinder No. 2 Left Bank	1 count in 0.0 hours
612	121-One Engine Speed Signal Lost	20 counts in 9.9 hours
613		
614	695-Right Bank Front Turbocharger Compressor Inlet Temperature Sensor Circuit Failed Low	4 counts in 51.6 hours
615	612-High Lubricating Oil Filter Restriction	12 counts in 64.2 hours

INFORM Fleet Management Software

- Fault snapshot - see graphically what was happening at the time a fault occurred



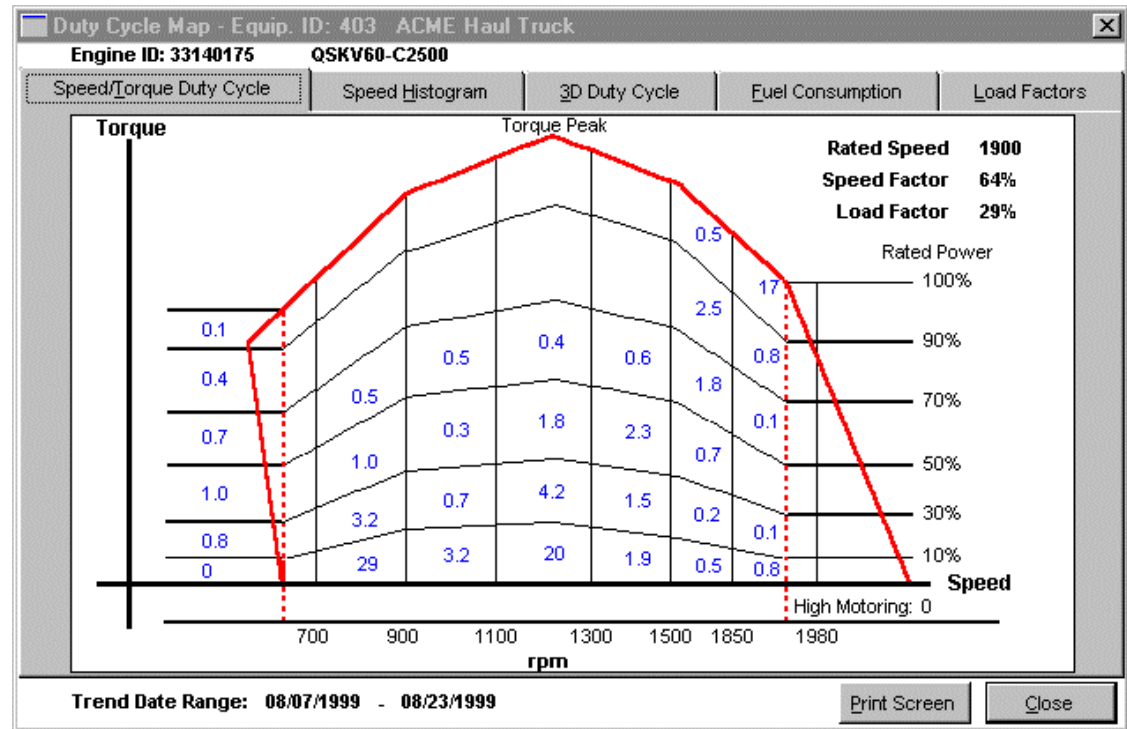
INFORM Fleet Management Software

- Engine Summary Report

02/21/2000			Engine Statistics Summary				Page 1	
All Equipment								
Engine Model K2000E								
Equipment	Engine Serial #	Location	Date of First Engine Data	Engine Availability	Projected Engine Life	Current Engine Hours	% Life	Proj. Engine Replace Date
544	33133991		02/18/1999	100.0%	32,000 hrs	20,679 hrs	64.6%	09/09/2002
545	33134142		02/18/1999	100.0%	32,000 hrs	20,473 hrs	64.0%	09/15/2002
Engine Model QSKV60-C2700								
Equipment	Engine Serial #	Location	Date of First Engine Data	Engine Availability	Projected Engine Life	Current Engine Hours	% Life	Proj. Engine Replace Date
610	33143228		10/12/1999	100.0%	25,000 hrs	841 hrs	3.4%	07/09/2004
611	33143027		10/01/1999	100.0%	25,000 hrs	552 hrs	2.2%	06/13/2004
612	33143432		08/23/1999	100.0%	25,000 hrs	1,072 hrs	4.3%	04/02/2004
613	33143241		10/15/1999	100.0%	25,000 hrs	136 hrs	0.5%	04/10/2004
614	33143593		10/21/1999	100.0%	0 hrs	56 hrs	N/A	N/A
615	33143615		11/23/1999	100.0%	25,000 hrs	92 hrs	0.4%	08/29/2004
616	33143694		11/18/1999	100.0%	25,000 hrs	90 hrs	0.4%	09/12/2004

INFORM Fleet Management Software

- Duty cycle maps
 - How hard is the engine being worked?
 - What speeds and loads?
 - Am I spending a lot of time at idle?



INFORM Fleet Management Software

- **Additional reports available:**
 - **Engine Replacement Forecast**
 - **Fuel Consumption**
 - **Equipment Out of Service for Repair**
 - **Lost time by Fault**

The CENSE System

- **On-board diagnostics and monitoring**
 - Engine protection
 - Advanced diagnostics and prognostics
 - Maintenance monitoring
- **Insite Service Tool**
 - PC-based Service Tool
 - View fault codes
 - Troubleshooting info on-line
- **INFORM Fleet Management Software**
 - Trending
 - Plan maintenance
 - Track equipment